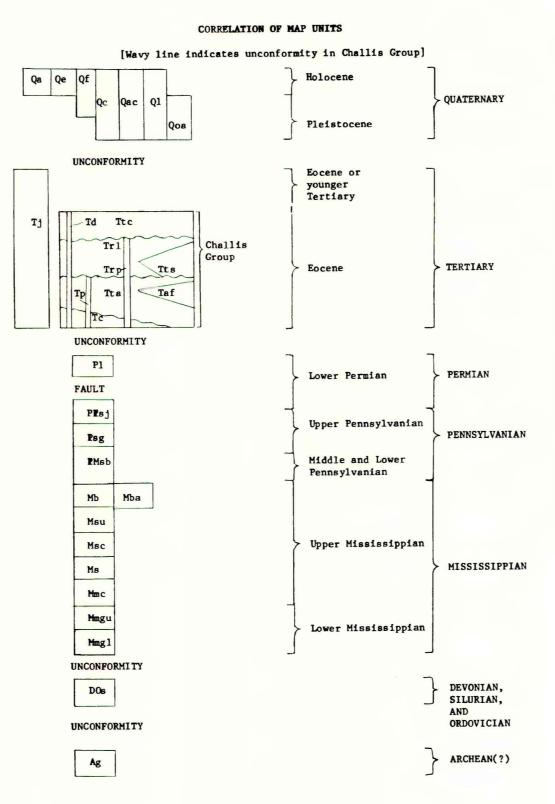


DEPARTMENT OF THE INTERIOR

No vertical exaggeration



DESCRIPTION OF MAP UNITS [Most color names from rock-color chart]

Alluvium (Holocene) -- Unconsolidated, poorly sorted deposits of fluvial gravel, sand, silt, and clay in present drainage systems. Maximum thickness a few tens of feet

Earthflow deposits (Holocene) -- Elongate to lobate hummocky deposits of unconsolidated to partly consolidated, poorly sorted debris containing much fine-grained material; common in tuffs. Maximum thickness a few iens of feet Alluvial-fan deposits (Holocene and Upper Pleistocene)-Fan shaped deposits of unconsolidated gravel, sand and silt that have been slightly modified by modern streams. Large east-facing fan in Antelope Creek is

outwash fan of Pinedale glaciation (Scott, 1982). Maximum thickness a few tens of feet Colluvium (Holocene and Pleistocene) -- Unconsolidated accumulations of soil and rock fragments that locally mantle and obscure bedrock: locally includes talu and frost rubble. Deposited by mass wasting processes. Maximum thickness a few tens of feet Alluvium and colluvium undivided (Holocene and Pleistocene) -- Unconsolidated deposits of gravel and

sand that grade downslope into alluvium or alluvia fan deposits. Maximum thickness a few tens of feet Landslide deposits (Holocene and Pleistocene)-Unconsolidated and partly consolidated rubble of coarse, mostly angular, unsorted debris derived from nearby bedrock and surficial deposits. Maximum thickness a few tens of feet Older alluvium (Pleistocene) -- Unconsolidated deposits of fluvial gravel, sand, and silt located above present

floodplains. Locally includes fan deposits. Maximum thickness a few tens of feet Jasperoid (Eocene and younger Tertiary)--Light-gray to black and medium-brownish-gray, aphanitic to fine-grained "silica rock"; commonly brecciated; sedimentary structures and fossils preserved locally; weathers light to moderate brown, brownish gray and gray to black; wind polished surfaces common; commonly a gradational contact 1 or 2 meters wide with unsilicified host bedrock; forms ledges and ridges: maximum thickness below surface about 200 ft. Scattered anomalous concentrations of base and precious metals identified in unit on the east side of Cherry Creek and in the Timbered Dome Basin areas (T.G. Lovering, written communs., 1972, 1974, 1975; Soulliere and others, 1988)

CHALLIS GROUP (EOCENE)

Rhvolite dikes--Light- to medium-gray and light- to medium-brownish-gray porphyritic rhyolite containing 5-25 percent small to large phenocrysts of twinned euhedral plagioclase (largely oligoclase), and anhedral, commonly smoky quartz, and, locally, sanidine. Plagioclase and quartz phenocrysts are present in all dikes; sanidine phenocrysts are in most, and in places are as long as 2 cm (centimeters). The large phenocrysts and subordinate, smaller, partly chloritized, rare phenocrysts of biotite, amphibole, and clinopyroxene are present in a finely- to medium-crystalline groundmass of potassium feldspar and quartz. The rock weathers yellowish gray, light orange, light greenish gray, and light to medium brownish gray; chilled black glassy margins a few cm thick are present locally: forms resistant ridges in places. These dikes intrude all other volcanic units in the area and are the youngest recognized intrusive phase of the local Challis magmatic event (see also Nelson and Ross, 1968. p. A14-A16) Tuffs of Little Chokecherry Canyon--Light-brownish-gray, grayish-red-purple, and light-olive-gray, densely

welded, largely devitrified, rhyolitic ash flow tuffs, comprising several cooling units. Tuffs contain 1-25 percent crystals of plagioclase, sanidine, quartz, biotite, and minor amphibole and pyroxene in a fine, shard-rich matrix that also contains abundant pumice and xenoliths of quartz sandstone, chert, and porphyritic volcanic rocks. Vesicular zones are common; individual vesicles are as long as 30 cm and as wide as 15 cm; most are smaller and more elongate. Tuffs weather brownish gray, grayish red purple, and olive gray. Local medium dark gray to black vitrophyres are porphyriti and perlitic in places. Unit unconformably overlies other Challis units. Thickness ranges from 300 to more than 1.000 ft. Estimated to be as much as 1,500 ft thick on cross section. Thicker to north. Dense. non-porphyritic vitrophyre was utilized by native Americans for arrow and spear points

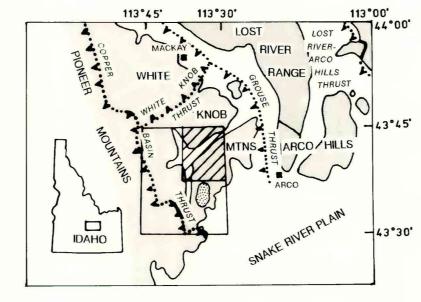


Figure 1. Index map of south-central Idaho showing location of the unpublished Mackay 4 NE quadrangle (diagonal lines) in relation to the published Grouse 15' quadrangle, major thrust faults (modified from Skipp, 1987), geographic features referred to in text (mountain ranges shaded), and location of the Champagne Creek subdistrict (stippled) of the Lava Creek Mining District.

Rhyodacite lavas--Grayish-red-purple, pale-red-purple, greenish-gray, brownish-gray, and medium-gray to grayish-black porphyritic to glomeroporphyritic rhyodacite and quartz latite lava flows containing 10-30 percent phenocrysts of plagioclase, pyroxene, hornblende, biotite, and minor potassium feldspar and quartz. Xenoliths of underlying volcanic units, argillite, quartzite, and granitic gneiss locally are common, especially near rhyodacite pipe (Trp) in secs. 13, 14, 23, and 24, T. 4 N., R. 24 E. Groundmass is very fine to fine-grained mosaic of plagioclase, quartz, opaque minerals, and potassium feldspar. Chilled glassy margins locally present; flow banding common. Lavas weather dark yellowish brown, moderate brown, grayish red, and dusky green; in areas of argillic alteration (indicated) they weather light gray to yellowish gray. Unit consists of numerous flows that are not mapped separately. Flows have apparent reversed magnetic polarity based on observations at 3 sites. The unit forms cliffs and irregular knobs. Thickness ranges from about 200

thick on cross section Rhyodacite pipe--Rock similar to rhyodacite lavas (Trl) but has subvertical flow banding throughout, is locally brecciated, and contains numerous xenoliths of underlying volcanic units and Paleozoic sandstone and argillite. Unit probably is a local vent for flows of unit Trl Tuffs of Stoddard Gulch--Grayish-red-purple, pale-redpurple, light-olive-gray, very pale orange, brownishgray to brownish-black, unwelded to densely welded, porphyritic rhyodacitic ash-flow tuffs interbedded

ft to more than 800 ft. Estimated to be 1,300 ft

with thin lava flows, and airfall and water laid tuffs. Ash-flow tuffs and flows contain 5-30 percent crystals of plagioclase, pyroxene, hornblende, biotite, and minor potassium feldspar and quartz in a fine-grained glassy or devitrified matrix. Inclusions of pumice fragments, volcanic rocks, sedimentary quartz sandstones, and metamorphic rocks are locally abundant. Vitrophyre and vitrophyre breccia, hyaloclastite, well-bedded light-colored airfall and waterlaid tuff are present in places. Eutaxitic structures are common. Densely welded parts of ash-flow tuffs and lava flows form ledges. Thickness ranges from 0 to about 300 ft. K-Ar age determination on hornblende from lower part of this unit is 44.3+2.7 Ma (R.F. Marvin, written commun.,

Andesite pipe--Grayish-green, coarse-grained, glomeroporphyritic andesite consisting of 30 percent or more epitaxial clusters of sericitized plagioclase crystals up to 4.5 mm in length, largely unaltered augite crystals, biotite pseudomorphs after hornblende and pyroxene, and magnetite in a fine-grained groundmass of plagioclase and biotite. Present only in isolated outcrop in southwestern corner of quadrangle where it intrudes tuff of Antelope Creek Tta Tuffs of Antelope Creek--Andesitic to rhyodacitic ash-

flow tuffs, air-fall tuffs, thin interbedded lava

flows, and minor volcanic sandstone, conglomerate, and breccia. Crystal-rich, welded ash-flow tuffs are gray, brown, grayish red and grayish green, and contain chiefly crystals of plagioclase and pyroxene in the lower part of the sequence and plagioclase, pyroxene, hornblende and biotite in the upper part Opaque oxide minerals, some sanidine, minor quartz, and accessary apatite make up a glassy or devitrified stony matrix that locally contains abundant pumice and volcanic lithic fragments; xenolithic sandstone fragments are present in places. Black vitrophyre and eutaxitic structure are common. Small vesicles are rare. The tuffs weather mostly moderate brown and dark yellowish brown, some are medium dark gray and yellowish gray. Interbedded, light-colored airfall tuffs commonly are biotite-rich. Thin lava flows have the same phenocrysts and volcanic lithic fragments as the ash-flow tuffs in a finely crystal line, locally felty, matrix. Argillic alteration is common, and secondary sericite, silica, chlorite, actinolite, and calcite are also present. Densely welded parts of the ash-flow tuffs and the lava flows form ledges; air-fall tuffs and sandstones form slopes. Thickness ranges from 300 to more than 1,000 ft. Estimated to be as much as 1,800 ft thick on

Taf Andesite flow--Moderate-brown-weathering, pale-brown, platy-weathering, porphyritic andesite containing crystals of augite, biotite, hypersthene, opaque iron oxide minerals and minor amphibole, potassium feldspar, and quartz in a fine-grained, felty matrix of plagioclase, potassium feldspar, quartz and opaque oxides. Clusters of pyroxene crystals and xenoliths of quartz sandstone are present. Unit mapped separately in Timbered Dome Basin where conspicuous subhorizontal planar jointing is present. Elsewhere, flow is mapped with tuff of Antelope Creek (Tta). Forms steep-sided rounded hills. Thickness ranges from 0 to 200 ft

cross section

Basal conglomerate, breccia, and sandstone--Lightcolored, poorly to moderately well consolidated, boulder to granule conglomerate and breccia containing lenses of fine- to coarse-grained sandstone. Conglomerate and breccia clasts as long as 60 cm composed of locally derived quartzite, limestone, sandstone, siltstone, argillite, and chert. Clasts are set in a matrix of light-gray sandstone or grayish-red mudstone. Both matrixsupported and clast-supported textures are common. Unit is thick-bedded, locally cross-bedded, and weathers moderate brown. Present only in north half of quadrangle. Outcrops probably are remnants of an Eocene alluvial fan system (Paull, 1974; Burton and Blakley, 1988). Unconformably overlain by volcanic rocks of Challis Group. Thickness ranges from 0 to

about 130 ft PALEOZOIC SEDIMENTARY ROCKS

Unnamed limestone (Lower Permian) -- Dark-gray to very dark gray, thin-bedded, argillaceous and silty, locally hosphatic, fossiliferous, fine- to coarse-grained limestone that weathers brownish gray, pale reddish brown and grayish orange. Coarse-grained bioclastic beds are cross-bedded and have cut-and-fill structures. Brachiopods are preserved with delicate spines in aphanitic beds. Abundant brachiopod and molluscan faunas indicate a Leonardian age equivalent to the Phosphoria Formation (Nelson and Ross 1969, 1970; Skipp and others, 1979). Unit found only in fault block on north side of Antelope Creek. Neither base nor top exposed. Minimum thickness 160 ft Snaky Canvon Formation (Lower Permian to Upper Mississippian) Juniper Gulch Member (Lower Permian? to Upper

Pennsylvanian) -- Light-colored, very fine- to finegrained, variably cherty and sandy dolomite and dolomitic limestone, with interbedded very fine grained, locally cherty, dolomitic sandstone, chert and quartzite pebble breccia and conglomerate, and bedded chert. Dolomite and dolomitic limestone are very light gray, pinkish and yellowish gray, and medium light gray; weathered colors similar to fresh colors with addition of light brown and light olive gray. Dolomite and dolomitic limestone are chiefly thick-bedded, and have moldic and intercrystal porosity. Lenses and nodules of light- to dark-gray banded chert and incipient chert locally constitute as much as 20 percent of carbonate beds. Sandstone is very light to light gray and yellowish gray, thick bedded, weathers light gray to light brown, and contains scattered light- to dark-gray banded chert lenses and nodules. Breccia and conglomerate in ledge-forming beds up to 42 ft thick, are light to medium gray, weather medium gray to light brown, are poorly sorted, and dominantly clast supported, and consist of angular to subrounded fragments up to 10 cm in diameter of chert, quartzite, argillite, and conglomerate. Matrix is both fine- to coarse-grained sandstone and carbonate. Chert is very light gray to medium gray, aphanitic, thin to thick bedded, locally laminated, and contains lenses of dolomite, and molds and casts of brachiopods, mollusks, corals, and crinoids. Faunas are poorly preserved and undiagnostic but stratigraphic position indicates a Late Pennsylvanian, and possibly Early Permian age. Conglomerates, breccias, and cherts form ledges: carbonates and sandstones are slope forming. Present only in southeastern part of quadrangle. Base and top of

member are covered, but minimum measured thickness is Gallagher Peak Sandstone Member (Upper Pennsylvanian)-Very light gray to grayish-orange, very fine grained, chiefly well-sorted, calcareous, quartzose sandston Also contains medium- to dark-gray, sandy, fossiliferous limestone, pale-brown calcareous siltstone, and minor lenses of pebble breccia and conglomerate. Sandstone is thin-bedded, locally laminated or crossbedded, weathers very light gray to pale yellowish brown, and contains local lenses of light-gray chert. Sandy limestone is fine to medium grained, largely bioclastic, very light to medium gray weathering, medium bedded, and contains brachiopods and pelecypods of Missourian age (J.T. Dutro, Jr., written commun., 1981). Conglomerate in lenses up to 3 ft in thickness is medium gray to light brown, chiefly clast supported, and consists of angular to subrounded chert and quartzite fragments up to 3.5 cm in diameter in a poorly sorted sandy matrix. Member is largely slope-forming except for ledges of conglomerate. Recognized only in southeastern corner of quadrangle. Top is covered; base is gradational with

underlying unit. Measured thickness of 190 ft

appears to be close to total thickness

Bloom Member (Upper Pennsylvanian to Upper Mississippian) -- Very light gray to grayish-black, mostly medium to dark-gray, chiefly impure, fossiliferous, variably cherty limestone, locally altered to jasperoid. Also contains minor interbedded light-gray, very fine grained, calcareous sandstone and siltstone. Darkgray to brownish-gray, chiefly calcareous, mudstone that weathers brownish gray to very pale orange is limited to the upper part of the member and is recognized only in the Timbered Dome Basin area. Limestone commonly is sandy, silty, or argillaceous, and weathers light to medium gray, light olive gray, and light brown. Contained sand is very fine to very coarse grained and consists of chert and quartz. Black to medium-gray chert and brown-weathering incipient chert in pods and lenses comprise 10 to 30 percent of beds in lower part. Limestone is thin- to thick-bedded, and cliff-forming thick beds are common in the basal 300 ft. Thinner beds form alternating slopes and ledges in remainder of member. Faunas and floras include algae, brachiopods, bryozoans, conodonts, conularids, corals, foraminifers, mollusks, pelmatazoans, and trilobites and indicate a Late Pennsylvanian to Late Mississippian age (Skipp and others, 1979; Skipp and others, 1985). Conodont color alteration index (CAI) values from lowermost limestones at Wood Canyon are 2 1/2-3, at Timbered Dome are 2-2 1/2 (J.F. Baesemann, written commun., 1982), and from upper beds on the north side of Antelope Creek are 2 (B.R. Wardlaw, written commun. 1978). Top and base of member are gradational with sandstone units above and below. Measured thickness

Bluebird Mountain Formation (Upper Mississippian)--Very light to medium-gray, very fine to fine grained, chiefly calcareous sandstone and siltstone that weathers with thin light-brown rind, and interbedded, similarly colored sandy or silty limestone, and minor light-gray chert in thin beds and lenses. Formation is thin to medium bedded and commonly forms ledges. Conodonts and calcareous foraminifers establish a Late Mississippian (Chesterian) age (Skipp and others, 1985). Sharp conformable contact with Arco Hills Formation below where present. Apparent gradational contact with Surrett Canyon Formation in Grouse area. The formation is finer grained in the northern part of the quadrangle where it is about 13 ft thick. It is 60 ft thick in the vicinity of Timbered Dome Basin. Mapped separately in northwestern part of quadrangle where mudstone of Arco Hills Formation was not found Bluebird Mountain and Arco Hills Formations undivided (Upper Mississippian) -- Bluebird Mountain Formation as described above underlain by thin, chiefly covered, sequence of brownish-gray to olive-black, calcareous laminated mudstone of the Arco Hills Formation that weathers brownish gray and pale red. Arco Hills Formation has a sharp conformable contact with Surrett Canyon Formation below. Measured thickness

of Arco Hills Formation is 13 ft and thickness of

is 2,200 ft in southeastern part of quadrangle

combined formations is 26 ft at Wood Canyon. At Timbered Dome Basin, Arco Hills is 15 ft thick and combined unit is 68.5 ft thick Surrett Canyon Formation (Upper Mississippian) -- Mediumlight- to dark-gray, medium-gray-weathering, chiefly pure, variably cherty, fossiliferous, medium- to thick-bedded, cliff-forming, locally cavernous limestone that is altered to jasperoid in places. Darker limestone beds have fetid odor. Black and light-gray chert in thin stringers and nodules comprise up to 25 percent of some beds in upper part, and thin beds and nodules of yellowish-brown-weathering incipient chert make up as much as 30 percent of some lower beds. Some silty beds are present in middle part. Thin silty and argillaceous limestone partings in upper part weather yellowish gray and gravish red. Phosphatic nodules and brachiopods are present in uppermost 30 ft near Timbered Dome Basin. Limestone is typically fossiliferous medium- to coarse-grained wackestone with lesser mudstone and packstone. Fossils include algae, brachiopods, bryozoa, conodonts, crinoids and echinoids, foraminifers, mollusks, ostracodes, and trilobites that indicate a Late Mississippian (Chesterian) age (Skipp, 1961; Nelson and Ross, 1970; Neely 1981). Conodont CAI values from limestones near top of Wood Canyon and Timbered Dome Basin measured sections are 2 1/2-3 and 2-2 1/2 respectively (J.F. Baesemann, written commun., 1982). Basal contact is gradational with underlying South Creek Formation. Measured thickness at Wood Canyon is 1,065 ft, but thicknesses determined from map along Antelope Creek near Grouse and

in the Timbered Dome Basin area are about 1,300 ft indicating a thickening to the west South Creek Formation (Upper Mississippian) -- Medium- to medium-dark-gray, chiefly thin-bedded, silty, finegrained limestone that weathers light gray, and contains scattered nodules of yellowish-brownweathering partly silicified incipient chert. Formation is poorly exposed, forms a valley between surrounding cliff-forming units, and is locally altered to jasperoid. A sparse fauna of brachiopods, bryozoa, pelmatazoan debris, a few corals and foraminifers in calcareous mudstones and wackestones indicate a Chesterian age. Basal contact gradational with underlying Scott Peak Formation. Thickness ranges from 295 ft in Ras Canyon (Neely, 1981) to 555 ft at Wood Canyon

Scott Peak Formation (Upper Mississippian) -- Medium- to medium-dark-gray, light- to medium-gray-weathering, chiefly pure, variably cherty, fossiliferous, thinto thick-hedded, cliff-forming, locally cavernous limestone that is altered to jasperoid in places. Some silty limestone beds are present and yellowishbrown-weathering incipient chert nodules and lenses are common in lower part. Black to light-gray chert, in lenses and nodules are scattered throughout but make up to 50 percent of some beds in the middle part. Limestone is fossiliferous, fine- to coarsegrained wackestone, packstone, and grainstone with lesser mudstone and boundstone. Abundantly fossiliferous upper two-thirds of formation contains algae, brachiopods, bryozoa, conodonts, corals, echinoids, foraminifers, mollusks, ostracodes, pelmatazoa, trilobites, and a few shark teeth that indicate a Late Mississippian (Meramecian and Chesterian) age (Skipp, 1961; Nelson and Ross, 1970; Neely, 1981). Basal contact is sharp and conformable in some places and gradational in others. Measured thickness along Antelope Creek near Grouse is 1,550 ft. At Wood Canyon the thickness of an incomplete section is 1.900 ft indicating a thickening to the east Middle Canyon Formation (Upper Mississippian) -- Medium-

gray to grayish-black, thin- to medium-bedded, chiefly fine- to medium-grained, spiculitic, silty limestone that typically weathers with a thin, lightgray to light-olive-gray rind. Silty limestone locally is altered to jasperoid. A few thin, noncalcareous siltstone beds are present in the basal few feet. Lower nonfossiliferous beds form steep slopes with silty chips; upper laminated beds are poorly exposed and contain a few brachiopods, bryozoa, and some crinoid debris. No diagnostic faunas have been recovered from this unit, but foraminifers and conodonts from the formation in the Lost River Range north of the quadrangle indicate a Late Mississippian (Meramecian) age (Mamet and others, 1971: Sandberg, 1975). The basal contact is gradational with the underlying McGowan Creek Formation. Measured thickness at Cherry Creek is McGowan Creek Formation (Upper(?) and Lower Mississippian) Upper member (Upper(?) and Lower Mississippian)-

Chiefly turbidites consisting of grayish-black to medium-gray, chiefly fissile mudstone that weathers light to dark gray, yellowish brown, and olive gray; nterbedded with varicolored thin-bedded siltstone, pale-red, olive-green, light-brown, and pale-yellowish-brown, medium- to thick-bedded, chiefly calcareous, very fine grained sandstone, and minor medium- to dark-gray, medium-bedded, aphanitic limestone. Mudstone commonly is laminated, locally calcareous, and forms steep slopes. Siltstone is laminated and graded beds, cross beds, and flute casts are common in both siltstone and sandstone. Unit is finer grained in upper part and, at Cherry Creek, mudstones are interbedded with grayish black limestone that weathers purplish in the uppermost 35 ft. Mudstones and siltstones have trace fossils of the Nerites Ichnofacies that is typical of deep-water distal turbidites (Seilacher, 1967), and the brachiopod Leiorhynchoidea polypleura (Girty) (MacKenzie Gordon, Jr., written commun., 1982). Mudstones and siltstones also contain rare wood impressions, mollusks, fish scales, and trilobites in addition to a few other brachiopods. The formation has been dated as Early Mississippian (Kinderhookian and Osagean) on the basis of conodonts in the Lost River Range to the north (Sandberg, 1975). Ammonoids found in the member south of the quadrangle suggest an Osagean age for most or all of the member (MacKenzie Gordon, Jr., written communs., 1981, 1988). Lower contact is gradational and is placed at the base of the stratigraphically lowest thick mudstone sequence. Thickness varies from 980 ft at Timbered Dome Basin

to 1,265 ft at Cherry Creek

Lower member (Lower Mississippian) -- Chiefly turbidites consisting of medium- to dark-gray, laminated, noncalcareous siltstone, medium- to dark-gray, fine- to coarse-grained sandstone, and medium- to dark-gray granule to pebble conglomerate in graded sequences. Siltstone weathers light gray and light olive gray and is thin bedded. Sandstone is chiefly medium bedded, weathers medium to light gray and moderate brown, and commonly is graded, contains flute casts, and minor cross beds or laminations. Sandstone contains rare, isolated rounded argillite or chert pebbles as large as 15 mm in diameter. Thin granule and pebble conglomerate weathers the same as the sandstone and contains scarce clasts of argillite or chert as large as 4 cm in diameter. Minor thin mudstone is present locally. No faunas were found in this unit. It is assigned an Early Mississippian age on the basis of stratigraphic position and lithologic similarity to the McGowan Creek Formation in the Lost River Range to the east (Sandberg, 1975) and the lower part of the Copper Basin Formation to the west (Nilsen, 1977). An unconformable lower contact with Devonian rocks is present south of the quadrangle. minimum thickness of 575 ft was measured at Cherry Creek, but a total thickness of 380 ft was measured in the Timbered Dome area south of the quadrangle, indicating thickening of the member to the northwest Devonian through Ordovician sedimentary rocks undivided-Devonian dolomite and Ordovician quartzite and dolo-

Unit shown only on cross section where thickness is estimated to be about 6,000 ft

Granitic gneiss (Archean?) -- Mottled-greenish-black and yellowish-gray, fine- to very coarse grained gneiss that has a cataclastic texture. Rock consists of quartz, plagioclase, potassium feldspar, and minor garnet. Ferromagnesian minerals are altered to magnetite, other opaque oxides, and minor amphibole Glass and glass altered to tridymite that are presen as thin films between some crystals represent partia melting of this rock. Unit is not exposed in quadrangle, but clasts of this lithology are present in Challis flows. Shown only on cross section. Thickness unknown

Precambrian and Paleozoic rocks in this quadrangle are a part of the Grouse thrust plate that probably was emplaced during mid-Cretaceous time in the southern White Knob Mountains of southcentral Idaho (fig. 1). Short wavelength concentric folds formed by interstratal slip in upper Paleozoic rocks east of Wood Canyon suggest that the lower bounding thrust, the Grouse thrust, may be present in mudstones of the McGowan Creek Formation 1,000 to 2,000 eet beneath the surface (cross section A-A'). A footwall ramp just west of these tight folds is inferred to explain the change from short wavelength folds on the east to longer wavelength folds west of Wood Canyon. At the western end of the cross section, east of Cherry Creek, the east-dipping panel of upper Paleozoic rocks is interpreted to be the foreland-dipping limb of a large fault-bend anticline formed above another footwall ramp in the Grouse thrust below the level shown in the cross section. The entire Paleozoic section and, possibly, Archean(?) gneiss were raised to elevations presently above sea level on this frontal ramp. Lower Paleozoic rocks and gneiss in the hanging wall of the thrust are inferred from the presence of large cobbles and boulders of quartzite and granite gneiss in the near-vent facies of rhyodacite lava flows of the Eocene Challis Group that unconformably overlie rocks of the thrust plate. Glass found in the granite gneiss boulders may have formed by partial melting of the gneiss at relatively deep crustal levels during Eocene Challis volcanism or possibly before mid-Cretaceous thrusting. The Grouse plate (equivalent to the eastern facies part of the White Knob thrust plate of Skipp and Hait, 1977) is overlain structurally by the Copper Basin and White Knob thrust plates to the west and north, respectively, and overlies the Lost River-Arco Hills thrust plate to the east (fig. 1). Pronounced lithologic differences in upper Paleozoic sequences distinguish rocks of the Grouse plate from the rocks of overlying plates. Rock sequences f the Grouse plate are similar to those in the structurally lower Lost River-Arco Hills plate (Skipp and Hait, 1977; Link and others, 1988). However, the Mississippian McGowan Creek Formation in the quadrangle is much thicker and coarser-grained than equivalent rocks in the Lost River Range and Arco Hills to the east. In addition, Pennsylvanian and Permian rocks in this quadrangle contain western-derived coarse-grained sand, sandstone and conglomerate not present in the equivalent, but finer-grained facies of the Lost River-Arco Hills thrust plate to the east (Skipp and Hall, 1980). A few outcrops of lower Paleozoic rocks of the Grouse plate southeast of the quadrangle resemble and are correlated with formations in the Lost River Range. On this basis, thicknesses and lithologies of this part of the stratigraphic section are thought to be somewhat similar to those of the Lost River Range. Because facies differences in all Paleozoic rocks appear to be minimal between the Grouse and Lost River-Arco Hills thrust plates, easterly transport of the Grouse plate probably was not great. Hypothetical offsets in Paleozoic rocks inferred from the cross section are about 5 miles. Three periods of Tertiary extension followed Mesozoic contraction: (1) post-thrusting and pre-Challis; (2) syn-Challis and (3) post-Challis. East-west-trending normal faults with small offsets cut all the Paleozoic rocks in the vicinity of Antelope Creek and Dry Fork, and, in most cases, do not cut overlying volcanic rocks. These structures suggest a post-thrusting and pre-Challis period of local north-south extension. Large calcite veins mapped in sec. 35, T. 5 N., R. 24 E. fill fractures oriented almost east-west. The general trend of dikes of Challis unit Td north and west of the quadrangle, however, is N 60°-70° E (Nelson and Ross, 1969) suggesting counter clockwise rotation of the extension direction during Challis time to northwest-southeast. Post-Challis Neogene extension faults generally trend north or northwest indicating an east-west or southwest-northeast extension direction. Most of the post-Challis faults are curved on the map, have west sides down, and tilt the Challis volcanics to the east. The antithetic fault near Schoolhouse Canyon is an exception. All of these faults may be listric at depth or merge on a regional detachment. The presence of unit Td along one of these faults in the SE/4, sec. 24, T.4 N., R. 25 E. indicates that some of them have a pre- or syn-Challis ancestry. The post-Challis normal fault in Cherry Creek is inferred to have introduced late normal movement on a Mesozoic hanging wall thrust imbricate in the Grouse plate. Major fracture and joint orientations are related to

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post-Challis tectonics. No fault scarps inferred to be

Pleistocene or Holocene were found in the area.

on the south (fig.1). Silver was produced during the late nineteenth century from rich oxidized ores in hydrothermally altered Challis Group volcanics from this subdistrict (Anderson, areas of alteration, no further study was made. Ni, and Zn in the northern part of the jasperoid outcrop. A showed elevated concentrations of some elements with strong indicate that metal-bearing solutions were present in the quadrangle and may have formed precious metal deposits in the vicinity of the jasperoids and jasperoid breccias. Conodont color alteration index (CAI) values of 2-3 from 1977). Carbonate rocks in the quadrangle, therefore, are potential dry gas reservoirs where extension faults have not breached available traps. Coeval carbonate rocks in both structurally higher and lower thrust plates than the Grouse plate have higher

Talus derived from the thin-bedded silty limestones of the Middle Canyon Formation is quarried near Grouse for road metal. Much of the limestone of the Scott Peak and Surrett Canyon Formaations is very pure where not silified or otherwise altered and could be used for cement or other uses requiring high purity.

alteration indices (Link and others, 1988; Harris and others,

mite crop out south of quadrangle. The existence at depth of these rocks in the quadrangle is based on these occurrences and the presence of large xenoliths of quartzite at the surface in flows and tuffs of the Challis Group. May include some Proterozoic rocks.

METAMORPHIC ROCKS

Anderson, A.L., 1929, Geology and ore deposits of the Lava Creek

'No mines are present in the quadrangle although it borders the Champagne Creek subdistrict of the Lava Creek Mining District 1929, 1947). The argillic alteration zones in the southern part of the quadrangle are the north margins of the alteration halo of the Champagne Creek subdistrict. Beyond identifying these small Jasperoid replacement of carbonate rock is widespread in both the Cherry Creek and Timbered Dome Basin areas. Early geochemical analyses of 5 samples from the jasperoid body on the east side of Cherry Creek by T.G. Lovering (written communs., 1972, 1974, and 1975) identified scattered anomalous concentrations of Au, Hg, Mo, recent geochemical study of 32 samples from the same area showed elevated concentrations of some minor and trace elements with a very strong Ag-Pb association east of Cherry Creek, and a moderate As-Sb-Tl association (Soulliere and others, 1988). Nine samples of jasperoid from the Timbered Dome Basin area in the same study associations of As-Sb-Hg-Cu-Pb-Zn and Ag-Tl. These associations upper Paleozoic limestones are anomalously low for the region, and are present even though the rocks have been intruded by dikes and plugs of the Challis Group. These values suggest that Mississippian and Pennsylvanian rocks of the Grouse plate were never buried beneath more than about 12,000 feet of overburden, and were never subjected to temperatures above 130 °C for very long. Known oil and condensate production, however, generally is from rocks with alteration indices less than 2; dry gas (methane) can be produced from rocks with indices as high as 4 to 4.5 (Epstein and others,

_____ Contact--Dashed where approximately located Fault-Dashed where approximately located; dotted where concealed.

Bar and ball on downthrown side. On cross section, arrow indicates relative movement; double arrow indicates movement in two directions; A indicates movement away from reader; T indicates movement toward reader

EXPLANATION

Anticline--Showing trace of axial plane ___ Syncline--Showing trace of axial plane Strike and dip of beds

Strike and dip of flow banding and eutaxitic structures

Strike and dip of prominant fracture and (or) joint sets Vertical Line of measured section

Argillic alteration Calcite veins Conodont color alteration index (CAI) value Ridge-top trench (Sackungen) X K-Ar age on hornblende

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This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

SEA LEVEL

GEOLOGIC MAP OF MACKAY 4 (GROUSE) NE QUADRANGLE, BUTTE AND CUSTER COUNTIES, IDAHO

By Betty Skipp